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RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT APPLICATION NO. 2813-2, Mineral Mountain Resources (SD) Inc.

Pursuant to SDCL 46-2A-2, the following is the recommendation of the Chief Engineer, Water Rights Program, Department of Environment and Natural Resources concerning Water Permit Application No. 2813-2, Mineral Mountain Resources (SD) Inc., c/o Bennett, Main & Gubbrud, 618 State St, Belle Fourche SD 57717.

The Chief Engineer is recommending APPROVAL of Application No. 2813-2 because 1) there is reasonable probability that there is unappropriated water available for the applicant's proposed use, 2) the proposed diversion can be developed without unlawful impairment of existing rights, 3) the proposed use is a beneficial use and 4) it is in the public interest with the following qualifications:

1. The well approved under this Permit will be located near domestic wells and other wells which may obtain water from the same aquifer. The well owner under this Permit shall control his withdrawals so there is not a reduction of needed water supplies in adequate domestic wells or in adequate wells having prior water rights.

2. The permit holder shall report to the Chief Engineer annually the amount of water withdrawn from the Crystalline Rock aquifer.

3. Water Permit No. 2813-2 authorizes a total annual diversion of 3.68 acre-feet of water for exploratory drilling.

See report on application for additional information.

Eric Gronlund

Eric Gronlund, Chief Engineer
October 21, 2020

REPORT ON PERMIT APPLICATION NO. 2813-2
Mineral Mountain Resources (SD) Inc.
OCT 15, 2020

Water Permit Application No. 2813-2 requests the appropriation of 3.68 acre-feet of water annually at a maximum pump rate of 0.022 cubic feet per second (cfs) (10 gallons per minute) from one well completed into the Crystalline Rock aquifer (700 feet deep) located in the NW ¼ SW ¼ Section 24-T2N-R3E for commercial and industrial uses for exploratory drilling. The well site is located approximately one half mile southeast of Rochford SD. Exploratory drilling will occur in section 1-T1N-R3E; section 7-T2N-R4E; section 11-T2N-R3E; section 12-T1N-R3E; section 12-T2N-R3E; section 13-T2N-R3E; section 14-T2N-R3E; section 18-T2N-R4E; section 23-T1N-R3E; section 23-T2N-R3E; section 24-T2N-R3E; section 25-T2N-R3E; section 26-T2N-R3E; section 35-T2N-R3E; section 36-T2N-R3E.

Aquifer: Crystalline Rock (CRSL)

Hydrogeology

The Crystalline Rock aquifers consists of localized aquifers in the Precambrian aged core of the Black Hills, where extensive fractures and weathering zones allow for the transmission of water (Driscoll & Carter, 2001). The Crystalline Rock aquifer is estimated to have an outcrop area of 540,000 acres (Rahn P. H., 1979). The Crystalline Rock that this application is completed into is composed of black graphitic slate and schist (Redden, Nichols, & Terry, 2015). The Crystalline Rock aquifer has very low primary porosity, so water movement in the aquifer is through secondary porosity (fractures, joints, and faults) (Rahn P. H., 1979). Secondary porosity for the Crystalline Rock aquifer is highly variable and uneven and therefore is site-specific. Rahn (1979) estimated an effective porosity containing recoverable groundwater primarily in cracks and joints that occur within a depth of 500 feet of ground surface to be one percent of the outcrop areas of the aquifer resulting in an estimated 2,700,000 acre-feet of recoverable water in storage for the Crystalline Rock aquifer in western South Dakota.

The well completion report included with the application indicates broken schist from ground surface to 30 feet, hard gray shale from 30 to 48 feet, schist fracture 2-3 gpm from 48 to 50 feet, hard grey shist from 50 to 210, schist fracture 5 gpm from 210 to 212 feet, hard grey shist from 212 to 338 feet, schist fracture 8 gpm from 338 to 340 feet, hard grey shist from 340 to 630 feet, schist fracture 9-10 gpm from 630 to 632 feet, and hard grey schist from 632 to 700 feet. The well completion report also indicated a static water level of 30 feet below ground surface (Water Rights, 2020b).

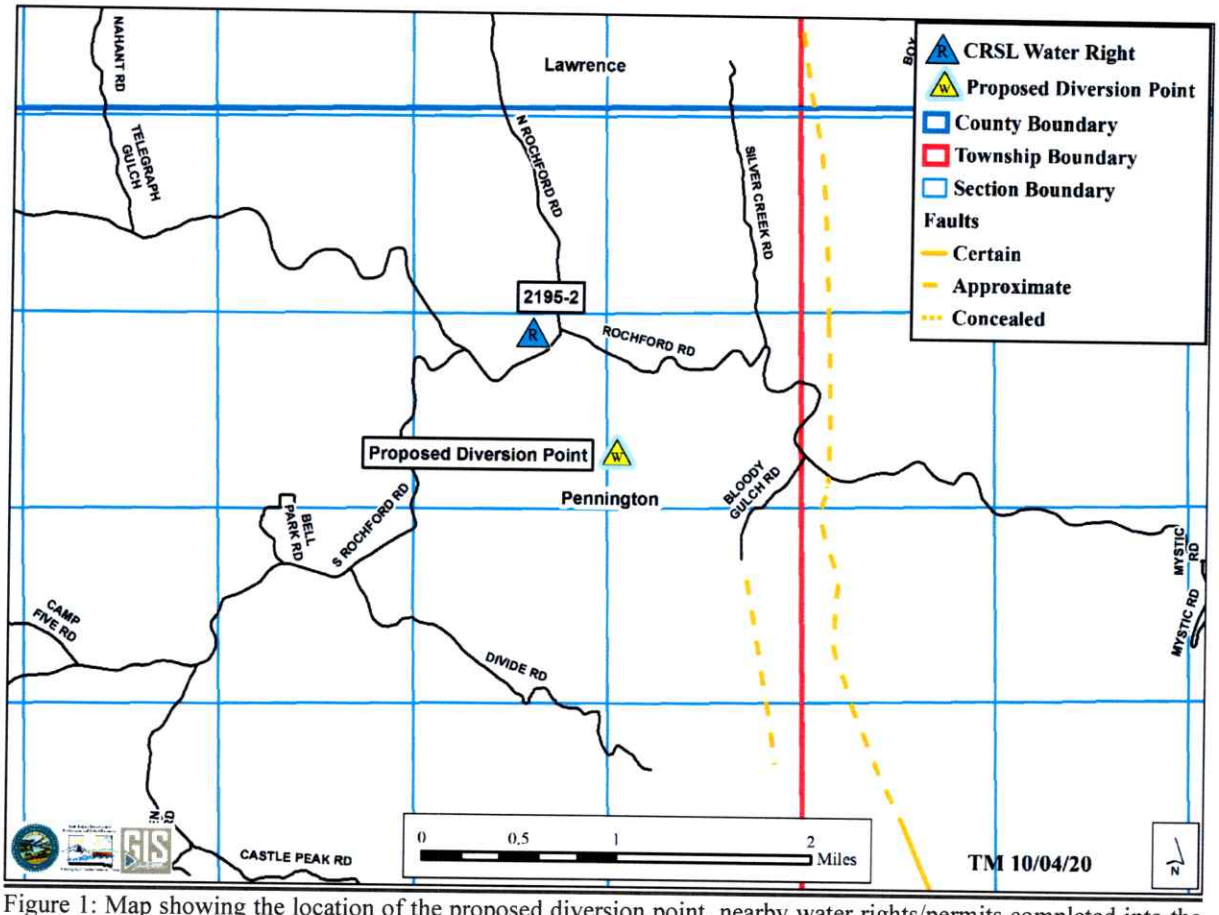

Figure 1: Map showing the location of the proposed diversion point, nearby water rights/permits completed into the Crystalline Rock aquifer, and fault locations (Water Rights, 2020a; Redden, Nichols, & Terry, 2015)

South Dakota Codified Law 46-2A-9

Pursuant to SDCL 46-2A-9, "A permit to appropriate water may be issued only if there is reasonable probability that there is unappropriated water available for the applicant's proposed use, that the proposed diversion can be developed without unlawful impairment of existing rights and that the proposed use is a beneficial use and in the public interest." This report will address the availability of unappropriated water and potential impacts to existing rights within the Crystalline Rock aquifer.

Water Availability

SDCL 46-6-3.1 is considered when evaluating the probability of unappropriated water from an aquifer and states, "No application to appropriate groundwater may be approved if, according to the best information reasonably available, it is probable that the quantity of water withdrawn annually from a groundwater source will exceed the quantity of the average estimated annual recharge of water to the groundwater source. An application may be approved, however, for withdrawals of groundwater from any groundwater formation older than or stratigraphically lower than the greenhorn formation in excess of the average estimated annual recharge for use by water distribution systems." The Crystalline Rock aquifer is older and lower than the Greenhorn Formation; however, there is no water distribution system involved.

Hydrologic Budget

Recharge

The Crystalline Rock aquifers receive recharge from the infiltration of precipitation and streamflow losses on the outcrop area (Driscoll & Carter, 2001). Driscoll & Carter (2001) estimated the recharge to the entirety of the Crystalline Rock aquifers for the years 1950-1998 within the core of the Black Hills to be equal to the average withdrawals (3,600 ac-ft/yr). Driscoll and Carter (2001) concluded that the recharge to the Crystalline Rock aquifers must be much larger than estimated to account for discharge to streams. Driscoll and Carter (2001) stated, in regard to the Crystalline Rock aquifers, "Recharge conditions are highly transient and have large spatial variability; thus, quantification is not attempted.". While looking at faults and other significant geological features may allow for some limiting of areal extent, there is not sufficient data available to attempt a delineation of the localized Crystalline Rock aquifer with any level of certainty. Therefore, there is no average annual recharge estimate available for the localized Crystalline Rock aquifer the applicant proposes to use.

Withdrawals

Currently, the nearest water right/permit (Water Right No. 2195-2 for Moonshine Gulch Saloon) authorized to withdraw water from the Crystalline Rock aquifer is approximately 0.8 miles to the northwest of the proposed diversion point, with the next nearest water right/permit being approximately 7.6 miles to the southeast of the proposed diversion point (Water Rights, 2020a). The amount of water that can be expected to be withdrawn by Water Right No. 2195-2 can be estimated assuming that the water right will pump at the maximum permitted diversion rate (0.015 cfs) 60 percent of the time resulting in 6.52 ac-ft/yr. This application, if approved, would authorize the appropriation of 3.68 ac-ft/yr assuming the application will use the entire permitted volume annually.

There are a number of well completion reports on file with the DENR-Water Rights Program for domestic wells that appear to be completed into the Crystalline Rock aquifer in the area of the proposed diversion point (Water Rights, 2020b). It is also likely there are other domestic wells completed into the Crystalline Rock aquifer in this area that are not on file with the Water Rights Program. In general, the volume of water pumped by domestic users is not significant to a hydrologic budget due to limited diversion rate (less than 18 gpm). Furthermore, in the Crystalline Rock aquifer it is common for most wells to produce less than 10 gpm with many users frequently getting less than 5 gpm from their wells. However, due to the unpredictable nature of the fracturing that comprises the localized Crystalline Rock aquifers, it is difficult to determine exactly how large a component of the hydrologic budget domestic use may represent.

Observation Well Data

In determining the availability of unappropriated water for a permit application, Administrative Rule of South Dakota (ARSD) 74:02:05:07 requires the Water Management Board to rely on the record of observation well measurements, in addition to other data, to determine that the quantity of water withdrawn annually from the aquifer does not exceed the estimated average annual recharge to the aquifer.

The SD DENR-Water Rights Program maintains two observation wells that have historically been considered completed into the Crystalline Rock aquifer in western South Dakota (Water Rights, 2020c). Observation well CU-86A is located approximately 24.3 miles southeast, and observation well PE-95D is located approximately 19.5 miles southeast of the proposed well sites. Kilts W. K. (2018) determined that observation well PE-95D is open to both the Deadwood Formation and the Crystalline Rock. It is uncertain how representative observation well PE-95D is of either the Deadwood or Crystalline Rock aquifers. For this reason, only observation well CU-86A will be used for analysis. Figure 2 shows the hydrograph for observation well CU-86A.

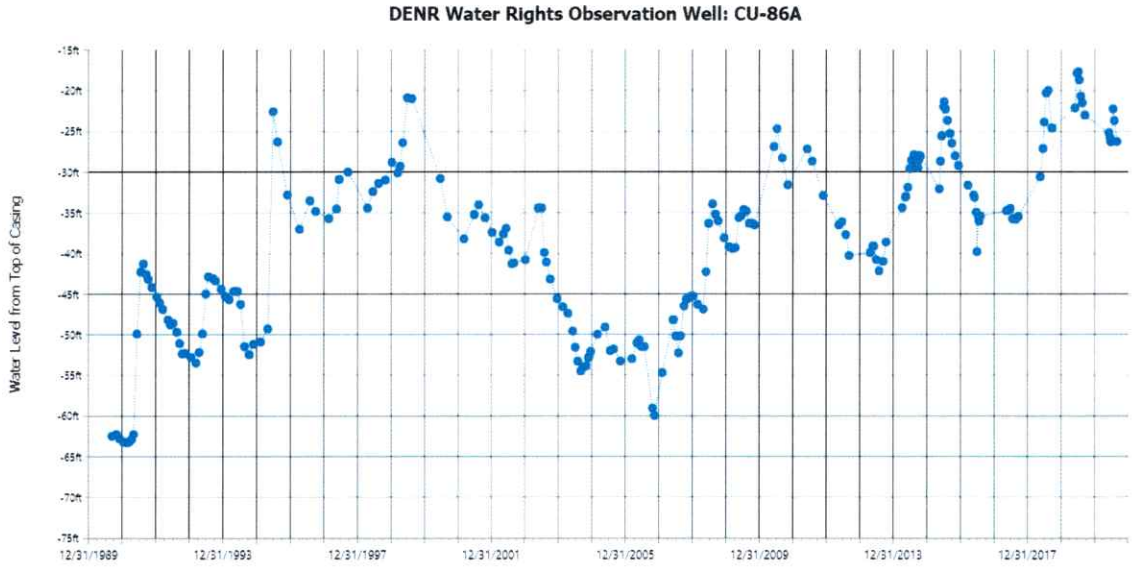

Figure 2: Hydrograph for observation well CU-86A (24.3 miles southeast) (Water Rights, 2020c).

Water levels shown in the observation well change in response to climatic conditions declining during drier periods and rising during wetter periods and show no or minimal responses to pumping. Any responses to pumping are relatively short term and are masked by recharge to and natural discharge from the aquifer. Over the period of record, the water levels for observation well CU-86A have fluctuated 45 feet. Recharge to and natural discharge from aquifers can be captured for pumping. Water level data for observation well CU-86A shows the Crystalline Rock aquifer receives recharge, and while the observation well is not close to the proposed diversion point, it still shows that the Crystalline Rock aquifers receive recharge.

Driscoll and Carter (2001) stated recharge to the Crystalline Rock aquifer must be much greater than the estimated 3,600 ac-ft/yr to account for the groundwater discharge that contributes to the base flow to many streams and is supported by the hydrograph for observation well CU-86A (Figure 2), which shows the water level generally rising over its period of record despite increased development of the aquifer.

When considering the hydrograph for observation well CU-86A, Driscoll's and Carter's (2001) commentary regarding recharge to the Crystalline Rock aquifer, the continued development of the Crystalline Rock aquifer, and the relatively small annual appropriation requested by this application, there is a reasonable probability unappropriated water is available for this proposed appropriation.

Potential For Unlawful Impairment Of Existing Water Rights

The nearest well completion report on file with SD DENR-Water Rights Program is approximately 0.5 miles to the northeast of the proposed diversion point for this application (Water Rights, 2020b). There are likely other wells completed into the Crystalline Rock aquifer within approximately 1 mile of the proposed diversion point for this application that are not on file with the SD DENR-Water Rights Program.

The nearest water right/permit (Water Right No. 2195-2) currently authorized to withdraw water from the Crystalline Rock aquifer is approximately 0.8 miles to the northwest of the proposed diversion point (Figure 1), with the next nearest water right/permit being approximately 7.6 miles to the southeast of the proposed diversion point (Water Rights, 2020a). Considering the proximity of Water Right No. 2195-2 to nearby domestic users (approximately 0.2 miles southeast) in the area without any reports of well interference and the limited diversion rate requested by this application, there is a reasonable probability this application can be developed without unlawful impairment to nearby adequate wells (Water Rights, 2020a; Water Rights, 2020b; Water Rights, 2019e).

An adequate well as defined in ARSD 74:02:04:20(6):

> "A well constructed or rehabilitated to allow various withdrawal methods to be used, to allow the inlet to the pump to be placed not less than 20 feet into the saturated aquifer or formation material when the well is constructed, or to allow the pump to be placed as near to the bottom of the aquifer as is practical if the aquifer thickness is less than 20 feet."

Due to the very low primary porosity of the Crystalline Rock aquifer and the highly variable and uneven nature of secondary porosity, 20 feet of saturated thickness may not be sufficient for a dependable water supply. Without conducting an aquifer pumping test, the precise drawdown effects caused by pumping a well cannot be determined. Over the period of record, the water levels for observation well CU-86A (Figure 2) have fluctuated 45 feet due to climatic conditions. Pump depth requirements are detailed in ARSD 74:02:04:60(2) which states "The depth of the pump setting shall be determined by dividing the specific capacity into the required yield and adding at least 10 additional feet to maintain pump inlet submergence below the maximum anticipated drawdown, where possible."

There has only been one reported instance of well interference in Pennington County for wells completed into the Crystalline Rock aquifer. This involved Water Right No. 2572-2 during the permit's initial development. The water right was limited to a maximum diversion rate of 18 gallons per minute, the limit for reasonable domestic use, by the Chief Engineer in October 2006. The permit holder reported to the Water Rights Program that the issue was resolved sometime before January 2009, and there have not been any other reports of well interference issues since then (Water Rights, 2019e).

Considering the continued development of the Crystalline Rock aquifer without a significant history of well interference complaints, the hydrograph for observation well CU-86A (Figure 2) and the natural fluctuations in water levels over the period of record, Driscoll's and Carter's (2001)

commentary regarding recharge to the Crystalline Rock aquifer, the protection afforded to adequate wells by South Dakota Water Law, and the relatively small annual appropriation requested by this application, there is a reasonable probability unappropriated water is available for this proposed appropriation. If this application is approved, a qualification requiring the applicant to control their withdrawals so there is not a reduction of needed water supplies in adequate wells should be included.

Conclusions

1. Water Permit Application No. 2813-2 requests the appropriation of 3.68 acre-feet of water annually at a maximum pump rate of 0.022 cubic feet per second (cfs) from one well completed into the Crystalline Rock aquifer (700 feet deep) located approximately one-half mile southeast of Rochford SD for exploratory drilling.

2. There is a reasonable probability that the diversion proposed by this application will not unlawfully impair adequate wells for existing water rights and domestic use.

3. There is a reasonable probability unappropriated water is available for this proposed appropriation.

Timothy Magstadt

Timothy Magstadt
Natural Resources Engineer II
SD DENR – Water Rights Program

Reviewed by:

Adam Mathiowetz, PE
Natural Resources Engineer III
SD DENR-Water Rights Program

References

Carter, J. M., Driscoll, D. G., & Hamade, G. R. (2001). *Estimated Recharge to the Madison and Minnelusa Aquifers in the Black Hills Area, South Dakota and Wyoming, Water Years 1931-98; Water-Resources Investigations Report 00-4278.* Rapid City, South Dakota: United States Geological Survey.

Driscoll, D. G., & Carter, J. M. (2001). *Hydrologic Conditions and Budgets for the Black Hills of South Dakota, Through Water Year 1998; Water-Resources Investigations Report 01-4226.* Rapid City, South Dakota: U.S. Geological Survey.

Kilts, W. K. (2018). *Report to the Chief Engineer Water Permit No. 2789-2 Rushmore Cave.* Pierre, South Dakota: SD DENR-Water Rights Program.

Rahn, P. H. (1979). *Ground Water Resources of Western South Dakota.* Rapid City: Department of Geology and Geological Engineering South Dakota School of Mines and Technology.

Redden, J. A., Nichols, C. E., & Terry, M. P. (2015). *Geologic Map of the Rochford Quadrangle, South Dakota 7.5 Minute Series Geologic Quadrangle Map 25: Scale 1:24,000.* Vermillion, South Dakota: SD DENR-Geological Survey.

Water Rights. (2019e). *Pennington County Complaint/Investigation File.* Pierre, South Dakota: SD DENR-Water Rights Program, Joe Foss Bldg.

Water Rights. (2020a). *Water Right/Permit Files.* Joe Foss Bldg., Pierre, South Dakota.: SD DENR-Water Rights Program.

Water Rights. (2020b). *Well Completion Report Files.* Joe Foss Bldg., Pierre, South Dakota.: SD DENR-Water Rights Program.

Water Rights. (2020c). *Observation Well Database.* Joe Foss Bldg., Pierre, South Dakota.: SD DENR-Water Rights Program.